Thraen in *Astronomische Nachrichten*, No. 3054, shows that the comet crosses the equator near the end of October :—

Ephemeris for Berlin Midnight.

1891.		Right Ascension. h. m. s.		Declination. ° ′ ″		Brightness.
Sept. 19	...	4 9 50·40	...	19 5 59·0	...	9·1
,, 21	...	13 7·99	...	18 17 29·3		
,, 23	...	16 16·09	...	17 27 4·4		
,, 25	...	19 14·09	...	16 34 48·7		
,, 27	...	22 1·58	...	15 40 44·3		
,, 29	...	24 38·50	...	14 44 57·2		
Oct. 1	...	27 4·25	...	13 47 32·4	...	11·2
,, 3	...	29 19·10	...	12 48 36·5		
,, 5	...	31 22·56	...	11 48 16·6		
,, 7	...	33 14·86	...	10 46 39·8		
,, 9	...	34 55·42	...	9 43 57·5		
,, 11	...	36 24·69	...	8 40 16·9		
,, 13	...	37 42·51	...	7 35 49·0	...	12·0
,, 15	...	38 49·17	...	6 30 45·1		
,, 17	...	39 44·06	...	5 25 18·0		
,, 19	...	40 27·92	...	4 19 38·1	...	12·1
,, 21	...	41 0·53	...	3 13 58·7		
,, 23	...	41 22·25	...	2 8 33·2		
,, 25	...	41 33·30	...	+ 1 3 35·1	...	12·0
,, 27	...	41 33·97	...	− 0 0 47·0		
,, 29	...	41 24·46	...	1 3 57·7		
,, 31	...	41 5·38	...	2 6 8·0		
Nov. 2	...	40 37·33	...	3 6 51·3		
,, 4	...	40 0·67	...	4 5 54·6		
,, 6	...	39 16·50	...	5 3 7·0	...	11·2
,, 8	...	38 25·07	...	5 58 14·5		
,, 10	...	37 27·44	...	6 51 6·6		
,, 12	...	36 24·07	...	7 41 33·4	...	10·4

It will be seen that the comet is now nine times brighter than at the date of discovery (May 4). The maximum brightness will be reached about October 19.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE Address of the President of the Geological Section having been devoted to the general questions involved in the origin, association, and working of coal, it was natural that other papers on the economic side of the science should claim considerable interest. Prof. Boyd Dawkins stated that the Channel Tunnel boring had been carried to a depth of 1500 feet, with the result of penetrating coal-measures dipping gently to the south at 1113 feet. Six seams, containing 10 feet of workable coal, had been pierced between that depth and the present bottom of the boring. The author endeavoured to show the probability that a thick series of coal-measures, with workable coals like those of Liége on one side and Somerset on the other, would be met with if the boring were continued, and pointed out the advantage possessed by the south-eastern coal-field in its moderate depth and the comparatively uncrushed character of the coal.

In an exhaustive paper Mr. Topley summarized the chief facts bearing on the origin of petroleum. He pointed out that, while the American oil was mainly derived from Palæozoic rocks, that in Europe and Asia came largely from Secondary beds, and the large Caucasian supply was drawn from rocks of Miocene age. The essential conditions for the supply of oil appeared to be, a porous rock, generally of sandstone or limestone, which served as a reservoir and was underlain by or contained beds largely consisting of organic remains, with an impervious cover of shale. In many cases the limestone had been dolomitized and transformed into a cavernous rock which was capable of storing the gas and oil. Such rocks can contain from one-eighth to one-tenth of their bulk of oil. The oil was driven to the surface by artesian pressure, and so gas was generally met with on the summits of anticlines and oil on their flanks. Where the rocks were very highly disturbed oil occurred, but not in very great abundance, while gas was rarely found.

Mr. Ross, in a paper on the same subject, endeavoured to prove that the oil was mainly generated by the action of solfataric volcanic energy upon beds of limestone, basing his conclusion on the occurrence of hydrocarbon and sulphurous vapours in solfataras, and the constant association of rock salt, dolomite, and gypsum with the rocks yielding petroleum. He exhibited equations to show that the action of sulphur dioxide and sulphuretted hydrogen on carbonate of lime, with or without water and peroxide of hydrogen, was capable of producing the ethylene and marsh gas derivatives, and he quoted experiments of Bischof to show that sulphur was formed by similar reactions, arguing that the hydrocarbons must be necessary by-products.

Sir Archibald Geikie communicated two most important papers on the results of Geological Survey work in the North-western Higlands. One of these papers, relating to the discovery of the *Olenellus* zone in the North-west Highlands, was as follows :—" Ever since the Geological Survey began the detailed investigation of the structure of the North-west Highlands of Scotland, the attention of its officers has been continuously given to the detection of any fossil evidence that would more clearly fix the geological horizons of the various sedimentary formations which overlie the Lewisian gneiss. A large collection of organic remains has been made from the Durness limestone, but it has not yet yielded materials for a satisfactory stratigraphical correlation. The study of this collection, however, has confirmed and extended Salter's original sagacious inference that the fauna of the Durness limestone shows a marked North American facies, though, according to our present terminology, we place this fauna in the Cambrian rather than in the Silurian system. Below the Durness limestone lies the dolomitic and calcareous shaly group known as the 'Fucoid beds,' which, though crowded with worm-castings, has hitherto proved singularly devoid of other recognizable organic remains. In following this group southwards through the Dundonnell Forest, in the west of Rosshire, my colleague, Mr. John Horne, found that, a few feet below where its upper limit is marked by the persistent band of 'Serpulite grit,' it includes a zone of blue or almost black shales. During a recent visit to him on his ground, when he pointed out to me this remarkable zone, I was struck with the singularly unaltered character of these shales, and agreed with him that if fossils were to be looked for anywhere among these ancient rocks, they should be found here, and that the fossil-collector, Mr. Arthur Macconochie, should be directed to search the locality with great care. The following week this exhaustive search was undertaken, and Mr. Macconochie was soon rewarded by the discovery of a number of fragmentary fossils, among which Mr. B. N. Peach, who was also stationed in the district, recognized what appeared to him to be undoubtedly portions of *Olenellus*. The importance of this discovery being obvious, the search was prosecuted vigorously, until the fossiliferous band could not be followed further without quarrying operations, which in that remote and sparsely inhabited region could not be at that time undertaken. The specimens were at once forwarded to me, and were placed in the hands of Messrs. Sharman and Newton, Palæontologists of the Geological Survey, who confirmed the reference to *Olenellus*. More recently Mr. Peach and Mr. Horne, in a renewed examination of the ground, have found, in another thin seam of black shale interleaved in the 'Serpulite grit,' additional pieces of *Olenellus*, including a fine head-shield with eyes complete. There may be more than one species of this trilobite in these Rosshire shales. The specific determinations and descriptions will shortly be given by Mr. Peach. The detection of *Olenellus* among the rocks of the North-west Highlands, and its association with the abundant *Salterella* of the 'Serpulite grit,' afford valuable materials for comparison with the oldest Palæozoic rocks of other regions, particularly of North America. The 'Fucoid beds' and 'Serpulite grit,' which intervene between the quartzite below and the Durness limestone above, are now demonstrated to belong to the lowest part of the Cambrian system. The quartzites are shown to form the arenaceous base of that system, while the Durness limestones may be Middle or Upper Cambrian. On the other hand, the Torridon sandstone, which Murchison placed in the Cambrian series, can now be proved to be of still higher antiquity. The marked unconformability which intervenes between it and the overlying quartzite points to a long interval having elapsed between the deposition of the two discordant formations. The Torridon sandstone must therefore be pre-Cambrian. Among the 8000 or 10,000 feet of strata in this group of sandstones and conglomerates, there occur, especially towards the base and the top, bands of grey and dark shales, so little altered that they may be confidently expected somewhere to yield recognizable fossils. Already my colleagues have detected traces of annelids and some more obscure remains of other organisms in these strata. These, the oldest relics of life yet known, have excited a vivid desire in the Geological Survey to discover further and more determinable fossils associated with them in the same primæval resting-place. We shall spare no pains to bring to light all that can be recovered in the North-west Highlands of a pre-Cambrian fauna."

In the other paper the Director-General dealt with some recent work of the Geological Survey in the Archæan gneiss of the North-west Highlands. "For some years past," he remarked, "the officers of the Geological Survey have spent much time and labour upon the investigation of the old or fundamental gneiss of the North-west Highlands. They have succeeded in showing that it consists mainly of materials which were originally of the nature of eruptive igneous rocks, but which by a long succession of processes have acquired the complicated structures which they now present. No evidence of anything but such eruptive rocks had been met with until the mapping was carried into the west of Rosshire. In that area it had long been known that the gneiss includes some mica-schists and limestones which were generally believed to be integral parts of its mass. With the accumulated experience of their work farther north, my colleagues were naturally pre-disposed to accept this view, and to look on even the limestones as the result of some crushing down and re-formation of basic igneous rocks containing lime-silicates. But as they proceeded in their work they encountered various difficulties in the acceptation of such a theoretical explanation. In particular, they found that with the mica-schist were associated quartz-schists and graphitic schists, and that the limestone occurred in thick and persistent bands with included minerals like those found in the Eastern Highlands in districts of contact-metamorphism. The microscopic examination of some of these rocks showed them to present close affinities to certain members of the crystalline series of the Eastern and Central Highlands, which can be recognized as consisting mainly of altered sedimentary strata (Dalradian series). Yet the officers of the Survey could not separate these doubtful rocks from the surrounding gneiss. The several materials seemed to pass insensibly into each other in numerous sections, which were examined with great care. Within the present month, however, one of the members of the staff, Mr. C. T. Clough, who has been specially engaged in this investigation, has obtained what may prove to be conclusive evidence on the subject. He has ascertained that the main bands of graphitic schist occur evenly bedded in an acid mica-schist, in which, also, thin graphitic layers are distributed at intervals of an inch or less. These rocks are sharply marked off from the true gneiss, though, where they actually join, they appear to be, as it were, crushed along a line of intense movement. Mr. Clough and his colleagues are at present disposed to believe that these schists are really an older series of sediments, into which the original igneous rocks now forming the gneiss were erupted. If they succeed in demonstrating the correctness of this inference, they will have established a fact of the highest interest in regard to the geological history of our oldest rocks. Already they have shown the thick masses of Torridon sandstone to be an accumulation of sedimentary materials of pre-Cambrian age. They will push back the geological record to a still more remote past, if they can establish the existence of a yet more ancient group of sedimentary strata among which layers of graphite and beds of limestone remain to suggest the former existence of plant and animal life."

The session on Monday was opened by Sir R. S. Ball with a paper on the cause of an Ice age. This communication stated that the author had a work in the press dealing with the question of glacial climates. He had revised Herschel's figures, on which Croll's deductions were based, and discovered an arithmetical error of considerable consequence. If 63 represents the number of heat-units received by any hemisphere during summer, its winter receipt will be represented by 37. Consequently, during a period of high eccentricity the 63 units of heat may be received in 199 days or in 166 days, according to the position of the equinoxes, producing either a long and cool summer or a short and intensely hot one. The paper did not deal with geographical considerations, and advocated the occurrence of clusters of alternate glacial and interglacial periods at each phase of high eccentricity in the earth's orbit. This paper excited considerable discussion, in which Prof. Sollas, Prof. Wright (of Oberlin, Ohio), Mr. Hall, Dr. Crosskey, Dr. Hicks, and many other glacialists took part.

Dr. Crosskey followed with his Report on the Distribution of Erratics in England and Wales, in which he referred to the useful work done by the North of England Boulder Committee, in systematically surveying the north in search of boulders and groups of boulders. Details were given of boulders from Lancashire, Cheshire, Derbyshire, Staffordshire, and Yorkshire, and it was remarked that boulders were being destroyed so rapidly that many described in former reports had totally disappeared. In another paper the same author controverted a statement of Forbes with regard to the glaciation of the Dovrefjeld. Wherever the basement rock is to be seen, it is glaciated, although morainic deposits were swept away and redistributed by torrential action at the close of the Glacial period.

Prof. Wright read a most interesting paper on the Ice age of North America and its connection with the appearance of man in that continent. The glacial deposits, transported from several centres mostly outside the Arctic circle, and the absence of a Polar ice-cap, militated against an astronomical, and for a geographical, cause of the great cold, particularly as an uplift of the glaciated area was coincident with an important subsidence in Central America. The author regarded the so-called "terminal moraine of the second period" as a moraine of retreat due to the first glaciation, and thought the evidence of forest beds, mainly to the south of the area, indicated local recessions of ice, and not a single great interglacial epoch. Palæolithic remains similar to those of the Somme and Thames have been found in several gravel terraces flanking streams which drain from the glaciated region, and made up of glacier-borne detritus; they are regarded by the author as deposits of the floods which characterized the closing portions of the Glacial period. The recession of the falls of Niagara and St. Anthony gives an antiquity of not more than 10,000 years to the end of the Glacial epoch—a conclusion supported by the enlargement of post-Glacial valleys and the silting up of small post-Glacial lakes.

Other papers read on this day were: one by Dr. Hicks, who produced specimens of boulders from Pembrokeshire, which seemed to him like North Welsh or Irish rocks—his picrite was, however, recognized as an Irish rock by geologists in the room, and in any case a flow of ice down the Irish Sea and over Pembrokeshire seemed to be clearly proved; one by Mr. Kendall, on a glacial section at Levenshulme, Manchester, in which he gave evidence from the striation of the subjacent rock, and the intrusion of tongues of boulder-clay into it, the transport of fragments, the orientation of large boulders, and the direction of striæ, together with a consideration of the levels of the different portions of the rock beneath, that the district had been traversed by land ice coming from a direction a few degrees north of west; and one by Mr. Bolton on a group of boulders from Darley Dale, near Matlock, which he regarded as having been washed out of rocks skirting the valley. In connection with these papers may be mentioned a report by Mr. Harrison, who has excavated in the talus under some rock-shelters at Oldbury Hill, near Ightham, from which he obtained forty-nine well-finished Palæolithic implements and over 600 waste flakes, which were described in a separate paper by Prof. Prestwich. Prof. Wright gave also a brief account of the basaltic lava beds of the Pacific coast, which are of post-Tertiary age. New evidence in favour of the genuineness of the Calaveras skull and other human remains found under the lava beds was given; and the discovery of a small clay image in a similar position under the western edge of the lava plains of Idaho at Nampa was recorded; the lava beds are correlated with the glacial deposits of the East.

Mr. Jones's report on the Elbolton cave, near Skipton, was of unusual interest. Long-headed human skulls were found with burnt bones and charcoal in the upper stratum, associated with domestic animals and pottery ornamented with diamond and herring-bone patterns; while at a much lower level—13–15 feet below the floor—there were round skulls, much more decayed, in connection with ruder and thicker pottery than has been found in any other part of the cave. No flints or metal of any kind have been found, and bone pins and other worked bones are the only human implements hitherto discovered. The remains of bear and hare have been found in cave earth below this level, and the investigation is to be continued in the hope that remains similar to those of the Ray Gill fissure may yet be met with.

An interesting discussion was raised on the paper by Dr. Hicks on the Silurian and Devonian rocks of Pembrokeshire and Devon. The Silurian rests transgressively on Ordovician and pre-Cambrian rocks in Pembrokeshire, but is covered by a continuous series up into the Old Red Sandstone and Carboniferous; similarly the Morte Slates, which the author regards as the oldest rocks of North Devon, and in which he has recently found *Lingulella Davisii*, are covered by the Devonian and Culm series of rocks. Mr. Ussher described the occurrence of a volcanic series in the Lower Devonian rocks of Tor Cross, and traced similar diabasic rocks amongst the chloritic series of Prawle Point, the excessive alteration of these rocks being due to the greater nearness to the old resisting rocks of the Channel. In this conclusion he was supported by Mr. Hunt, who described the occurrence of detrital tourmaline in the Devonian cliffs at the north-east end of Straiton Sands, and compared it with the occurrence of similar material in a quartz-schist west of the Start Lighthouse. Both schists and sandstone contain detrital tourmaline, mica, fine-grained quartz, and iron.

Several palæontological papers were contributed. Mr. Montagu Browne exhibited teeth, scales, and bones of Colobodus from Aust, Watchet, and Leicestershire, which seemed to indicate the identity of Colobodus with Lepidotus, and possibly of Heterolepidotus with Eugnathus, and to give Colobodus an extended upward range. Mr. Buckman gave an account of the Ammonite zones in the Inferior Oolite. There is a marked break on the Continent between the *Murchisonæ* and the *Sowerbyi* zones, which appears to be filled up by the zone of *Lioceras concavum* in England. The *Sowerbyi* zone, however, is absent in England from all localities except Dundry, and Coombe near Sherborne; and the author therefore sought and obtained a grant to open an old quarry at the latter locality, in order to fully investigate the fauna of the *Sowerbyi* zone, and its relationship to the *concavum* and *Sauzei* zones. Mr. Storrie, of the Cardiff Museum, exhibited a fine series of slides and drawings of *Pachytheca* and *Nematophycus*, and gave a minute description of them; this elicited some discussion, in the course of which Mr. Murray suggested that the former might possibly be the egg of a Crustacean or some other small organic body completely incrusted by a Nullipore. Mr. Smith Woodward exhibited Pterodactyl and Plesiosaur bones from Brazil, and gave an account of a series of Miocene fish-remains from Sardinia. Other palæontological papers were one containing a record of the occurrence of a variety of *Estheria minuta* in the Lower Keuper building-stone of Chester, by Mr. De Rance, and one by Mr. Vine on the Bryozoa of the Upper Chalk. Mr. B. Thompson gave an exhaustive report of the transition bed between the Middle and Upper Lias in Northamptonshire, from which he had obtained a large and valuable series of fossils. Mr. Newton described the occurrence of *Ammonites jurensis* in the Northampton sands, near Northampton; and Prof. Hoyes Panton gave an account of a mastodon of very large size at Highgate, Ontario, and a mammoth from Shelburne, in the same province.

The occurrence of a strip of Lower Greensand four to five miles long between Shaftesbury and Child Okeford, and running parallel to the valley of the Stour, was described by Mr. Jukes Browne. The same author attempted to explain monoclinal flexure by the recurrence of movement in rocks already faulted, but covered subsequently by unconformable strata; movement along the faults of the older series, under the influence of new pressure, would throw the overlying series into monoclinal folds or faults. The existence of a large area of Kellaways rock, near Bedford, and the extension of Fuller's-earth works at Woburn were commented on by Mr. Cameron.

Several of the Committees appointed last year had done good work. The Photograph Committee had obtained over 250 new photographs of geological interest, many of which were exhibited in the Section-room or at one of the *soirées*, where also Prof. Wright displayed a fine series of transparencies illustrating the lava and glacial deposits of the United States, and Mr. Stirrup a set of slides of the dolomite district of Languedoc. The Earth-Tremor Committee had been testing a number of recording-instruments; Mr. Smith Woodward reported that the lists of type specimens were progressing, and that many large Museums were publishing their own lists of types; Mr. De Rance gave an account of a number of wells in Yorkshire, Lincolnshire, Notts, Cheshire, Shropshire, and Glamorganshire; and Mr. Johnston-Lavis sent a description of the Vesuvian eruption of 1890–91, the chief part of which has already appeared in the columns of NATURE.

BIOLOGY AT THE BRITISH ASSOCIATION.

THE papers read at this Section were fully as interesting, though not quite so numerous, as usual. A good deal of time on one day was occupied by a discussion upon animals and plants; but as several of those who took part in the discussion did not wish their remarks to be reported, it has been thought better to leave out this part of the proceedings of Section D. Botanical papers preponderated over zoological, but it was not found necessary to divide the Section into two sub-Sections.

Mr. Grenfell read a paper upon the structure of Diatoms, describing pseudopodia in these organisms. The pseudopodia are quite easy to see in such a form as *Melosira* with even a comparatively low power. They are very long and stiff, radiating outwards from the periphery, and are apparently non-retractile (they were watched for an hour without any movements being observed); the pseudopodia are sometimes nine times the length of the diameter of the Diatom, and are occasionally branched; adjacent Diatoms were sometimes seen to be connected by a fusion of their pseudopodia. It was suggested that the use of the pseudopodia is to keep the plants floating, and to act as a protective *cheveux de frise* against their enemies. These Diatoms were compared to Heliozoa, with which they have evidently not a little resemblance in the form of the pseudopodia. Incidentally Mr. Grenfell stated that he had found a coating of cellulose upon the green corpuscles of *Archerina*, which were regarded by Lankester as chlorophyll bodies, and not as symbiotic algæ.

Mr. Wager described the presence of nuclei in Bacteria; they were met with in a species of *Bacillus* found in water containing decaying *Spirogyra*.

Dr. Gilson read a paper upon the nephridia of the leech, *Nephelis*. The ciliated funnels appear to lose their connection with the rest of the nephridium, and to perform the function of organs for the propulsion of the blood along the channels in which they lie.

The Plymouth Zoological Station sent a record of work done during the last year by the Director and by Mr. Cunningham.

Mr. Calderwood read a paper upon some economical investigations which had been carried out. He stated that three investigations had been started within the present year, which it was hoped would prove of great value to the fishing population of this country. One was an attempt to produce an artificial bait for use in long line fishing. This investigation was being carried on by a competent chemist, and a considerable advance had already been made towards a satisfactory solution of this difficult problem. Inquiries were also being conducted with regard to the occurrence of anchovies on the south-west coast of England, and Mr. Cunningham, the Naturalist of the Association, had carried out some inquiries at fishing stations on the south coast. At present no net small enough in the mesh to capture anchovies was employed, but that fish appeared so often when the ordinary pilchard nets became entangled, as to suggest that they might be present in considerable quantities. Anchovy nets had, therefore, been constructed, and would be used during the pilchard season this autumn. An investigation was also being carried on into the condition of the North Sea fisheries, which were declared to be rapidly declining. It was proposed to draw up a history of the North Sea trawling grounds, comparing their present condition with their condition some twenty or thirty years ago, when comparatively few boats were at work; to continue, verify, and extend observations as to the average sizes at which prime fish, such as soles, turbot, and brill, become sexually mature, and to collect statistics as to the sizes of all fish captured in the vicinity of the Dogger Bank and the region lying to the eastward, so that the number of immature fish annually captured may be estimated. Also to make experiments with beam trawl nets of various meshes with a view to determine the relation, if any, between the size of mesh and the size of fish taken. Mr. Calderwood added that a regular survey of the English Channel had been commenced, not only in the deep water, but in various estuaries. A meteorological station of the second order had been recently established, where observations at 9 a.m. and 9 p.m. would be taken daily by wet and dry bulb thermometers, barometers, rain-gauges, and sunshine-recorders.

Mr. J. T. Cunningham read a paper upon the reproduction of the pilchard. The ovum of this fish, described as such in the Journal of the Association for 1889, was stated by Pouchet